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IS THE OVER-EDUCATION WAGE PENALTY PERMANENT?

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Is the Over-Education Wage Penalty Permanent?

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Abstract: Much has been written about the impact of over-education on wages using cross-sectional data, although there have been few studies that analyse the returns to over-education in a dynamic setting. This paper adds to the existing literature by using panel data to investigate the impact and permanence of over-education wage penalties, whilst controlling for unobserved individual heterogeneity. Our fixed effects estimates suggest that the over-education wage penalty cannot solely be explained by unobserved heterogeneity. Over-education is permanent for many workers since around 50 percent of workers over-educated in 1991 are still over-educated in 2005. However, we also show that these workers are of lower quality compared to around 25 percent who find a match within five years of being over-educated. Finally, there is a significant scarring effect for workers over-educated in 1991 since they never fully reach parity compared to those who were matched in 1991, although this is not the case for graduates who manage to find a match within 5 years.

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I INTRODUCTION

Numerous studies have observed the phenomenon of over-education, whereby individuals perform jobs for which they are apparently overqualified, and have investigated its effects. There is now a convincing body of evidence that consistently shows that an individual who is over-educated for their job will earn more than their colleagues who are correctly qualified, but less than individuals with the same education level as them, who have found an appropriate job. In other words, while there are some wage returns to the years of unused education for over-educated individuals, they suffer a penalty in that they do not obtain the full return that they could expect if they were to work in a job that fully utilised their education level.

Almost all the evidence in the literature on this relationship uses cross-sectional data. This paper uses panel data from the UK, in order to answer three key questions about over-education:

(i) How much of the wage penalty associated with over-education is due to unobserved characteristics of individuals, which made them more likely to appear overeducated in the first place?

(ii) Is the wage penalty associated with over-education constant across all individuals, or does it vary according to whether the individuals concerned subsequently move out of the over-educated state into a matched job?

(iii) Do those individuals who do escape over-education into a matched job achieve similar wage outcomes to those who were always matched, or are they always at a disadvantage in the labour market?

The underlying theme behind each of these questions is whether there are differences in the unobserved characteristics between individuals who are over-educated and those who are not, and those who escape over-education and those who do not. The answers to these questions will greatly improve our understanding of the causes and consequences of over-education.

The impact of over-education on wages is an important policy issue, given the significant rise in higher education (HE) participation in recent years, both in the UK and other countries. The Higher Education Initial Participation Rate (HEIPR) shows that 43% of English young people have participated in Higher Education by the age of 30[1]. Although the definition of the rate has changed slightly over time, a similar participation rate was below 20% at the beginning of the 1990s, with much of the subsequent growth occurring before 2000. Below degree level, the number of seventeen year olds still in education in the UK increased from 672,000 in 1995/6 to 807,000 in 2005/6, while their achievement rates increased at the same time (for example, the proportion of participants achieving 2 or more A Levels, i.e. reaching Level 3 on the National Qualifications Framework (NQF), increased from 30% to 37% over the same period.[2]) These figures imply an increase in the number of qualified workers who have recently entered, and will continue to enter, the UK labour market, as in most other countries.

The next section of the paper describes in more detail the various theories that have been proposed to explain the existence of over-education, focussing on the unobserved heterogeneity argument that is the subject of this paper. This will be followed by two sections explaining the empirical methodology and the data set to be used. Sections V-VII contain the results of the analysis, each focussing on one of the questions highlighted above. The final section offers some conclusions.

II WHY MIGHT OVER-EDUCATION EXIST?

Various reasons have been put forward for why over-education might exist. One of the earliest contributions was that of Freeman (1976), who suggested that aggregate over-education should be a short-term disequilibrium phenomenon. If there is an over-supply of skilled workers, this should be followed by a fall in the wage return to their skills, which in turn should either reduce supply again, or increase employer demand for skills, until any excess supply of skilled labour is eliminated. Previous evidence in the over-education literature, for many countries and many points in time from the early 1980s onwards, suggests *aggregate* over-education is a permanent feature of modern labour markets. In addition, there is little evidence of any recent decline in the graduate wage premium, as predicted by this theory. It therefore seems that over-education at the aggregate level is not caused, in the main, by an over-supply of skilled workers. Research has therefore looked to the level of individuals workers and jobs to explain the existence of over-education.

Three potential explanations have been identified in the literature. These are that (i) even though aggregate over-education is a permanent phenomenon, over-education is temporary for the individuals concerned, who have entered a firm at a level below their skill level, but who quickly expect to be promoted within the firm as they gain experience[3]; (ii) that individuals have restricted mobility in the labour market, perhaps due to family constraints, and have to accept a local job, even if it is not commensurate with their skills[4]; and (iii) that individuals with the same level of education are heterogeneous in their abilities, so that the less able may be apparently over-educated in terms of their actual qualifications, but actually have skills that are commensurate with their jobs.

It is this third explanation for over-education that this paper focuses on. The three wage equation analyses described in the introduction will all investigate the existence of unobserved heterogeneity in skills, and their link to over-education. In particular, the analysis in Section V will examine how much of the wage penalty associated with over-education disappears once we control for unobserved heterogeneity, which would be consistent with the idea that heterogeneity in skills was responsible for that part of the wage penalty rather than the over-education status itself. In the limit, where wages are *only* a function of individual characteristics and not at all a function of job characteristics, as Human Capital Theory contends, then an implication of this idea is that, if we can successfully control for unobserved heterogeneity, then over-education wage penalties should disappear completely, and individuals should earn the same whatever job they do.

The second wage analysis in Section VI considers the variation in the wage penalty associated with over-education, according to whether or not the individuals concerned subsequently move out of the over-educated state into a matched job. If the original over-education penalty is the same for both groups of individuals, this would suggest that the observed over-education is actually an under-use of skills for those who find themselves in this situation (due perhaps to reasons i or ii above), with wages being determined by the jobs that they do. On the other hand, if the original over-education penalty is smaller for those who subsequently leave over-education, this would suggest that wages are being determined by characteristics of the individuals as well, with the difference in wage penalties amongst the initially over-educated reflecting heterogeneous abilities, which are unobserved in the data but are, presumably, observed by future employers.

Finally, the analysis in Section VII considers the difference in wages between individuals who have always worked in a matched job, and individuals who now work in a matched job but were previously over-educated. If there is no such difference in wages, the earlier over-education wage penalty suffered by the latter group can be attributed to the characteristics of their previous job, and therefore genuine over-education. However, if the previously over-educated never catch up, in terms of their wages, with those who were always matched, this would suggest lower unobserved heterogeneous ability influencing their current wages, and hence also their previous over-education experience.

Analysis of the 'heterogeneous ability' hypothesis has been provided by a limited number of previous papers. Some studies have shown that observed factors associated with ability help determine over-education status. For example, Buchel and Pollmann-Schult (2001) show that individuals with similar levels of formal education in West Germany differ in their likelihood of being overqualified, with these differences being related to school achievement and type of vocational training undertaken. Alternatively, the over-educated may not have low skills, but simply the 'wrong' skill for the labour market. In the UK, Dolton and Vignoles (2000) find that graduates of social sciences, arts and languages are more likely to be over-qualified than graduates of subjects in high demand and short supply in the labour market, such as engineering and sciences. Frenette (2004) obtains similar findings in Canada, with graduates in fine arts, humanities, social sciences and agricultural and biological sciences being less likely to find graduate level work, relative to graduates in education, engineering, computer science, law and medicine.

Although there is a large literature looking at the wage penalty to over-education[5], relatively few studies have used the wage equation results to infer the causes of over-education. Exceptions include Chevalier (2003), who measures unobserved skills via the residual from a wage equation based on earnings in graduates' first job, and finds that the inclusion of such unobserved skills in the wage equation for the current job reduces the pay penalty on over-education, but only by a small amount (around 8%). Allen and van der Velden (2001) and Green and McIntosh (2007) both include a measure of skill utilisation in their wage equations to capture whether workers are well matched or not in

terms of their actual skills rather than their qualifications. Both find only a small reduction in the wage penalty to over-education when skill utilisation is controlled for.

Panel data have rarely been used in the literature when estimating the wage impact of over-education. Bauer (2002) uses German Socio-Economic Panel data, to show that the penalty to over-education declines when fixed effects are included in the wage equation to control for unobserved heterogeneity. Similar findings are obtained by Frenette (2004) for Canada. Our first wage equation analysis replicates these results for the UK. No other papers, however, have used panel data to undertake the two other analyses of wage equations that follow in this paper, to the best of our knowledge.

III METHODOLOGY

In the analysis that follows, qualifications are measured in terms of the highest level achieved, on a scale from NQF Level 0 (no qualifications) to NQF Level 6 (tertiary qualifications), as shown in Table 1. Worker *i* is defined as over-educated if his actual highest qualification (HQ_{it}) exceeds the required highest qualification in his occupation *j* (RQ_{ijt}) at time *t*. Following studies such as Battu and Sloane (2004), Bauer (2002), Kiker *et al.* (1997) and Mendes de Oliveira *et al*. (2000), we measure required qualifications as the modal highest qualification in each occupation, measured at the 3 digit level in the Standard Occupational Classification. This methodology is a variation of that originally proposed by Verdugo and Verdugo (1989), who measured the required amount of education by the *mean* level of education amongst workers in the individual's occupation,

and defined someone to be over-educated if their actual education level was at least one standard deviation above this mean level. Using the mode rather than the mean seems preferable as it does not require the arbitrary use of one standard deviation, and it will be less affected by outliers, as argued by Mendes de Oliveira *et al*. (2000).[6]

Whether the mean or mode is used, one criticism of this methodology to measure required education is that it is determined by actual qualifications held, rather than by the requirements of the job. If there is a general rise in the qualification level of the population, then we would expect the average qualifications of workers hired in all occupations to rise (the mean immediately, and the mode only after the tipping point in the most frequent qualification is reached). Thus, even if the job requirements have not changed at all, an increase in qualifications held will increase the measured required education and so lead to an underestimate of the incidence of over-education. We do not think that this is a serious problem over the period considered however. The wage gap between the high- and low-educated has not fallen at any point over the last 25 years in the UK, and increased rapidly at certain points in time, particularly in the 1980s. The large literature seeking to explain this rise in wage inequality has generally concluded that the demand for skilled or educated workers has risen faster than the supply[7]. We therefore do not think that our chosen measure of required qualifications is unduly affected by such grade inflation, where higher qualifications are asked for simply because they are available in the workforce, rather than actually required.

To assess the effect of education on earnings, we estimate a variation of the over-required and under-required (ORU) specification of Hartog (1997). Our model includes dummy variables for each level of required education (RQ^m_{it}) for m=1…6, NQF Level 0 forming the reference category. Over-education is measured using 5 dummy variables (D^k_{it}) showing the distance (number of levels) between actual and required qualifications when this value is positive (k levels where k=1…5). No individual in the sample has an over-education distance value of 6, i.e. no individual has a postgraduate qualification (NQF Level 6) and works in a job requiring no qualifications (NQF Level 0). This flexible specification therefore allows returns to required education and over-education to increase non-linearly across levels. A categorical variable is also included to indicate levels of under-education, SU_{it}.[8]

$$\boldsymbol{Y_{it} = \beta X_{it} + \gamma_1 RQ^1_{it} + \ldots + \gamma_6 RQ^6_{it} + \delta_1 D^1_{it} + \ldots + \delta_5 D^5_{it} + \mu SU_{it} + \varepsilon_{it}} \quad \textbf{(1)}$$

Y_{it} are real (2005 prices) log gross weekly earnings and X_{it} contains relevant socio-economic and job characteristics for worker i at time t, that can explain earnings.

We estimate the parameters in equation (1) first using OLS, and then using a fixed effect estimator to allow for the possibility that unobserved heterogeneity biases the parameters through correlation between education and the error term ε_{it}. If unobserved heterogeneity is the only reason why individuals work in jobs for which they are apparently over-educated, then once we control for this, an individual should earn the same whatever job they do, determined by their abilities. If this is the case, then the returns to an incremental level of over-education, $\delta_k - \delta_{k-1}$, should be the same as the returns to an incremental level of required education, $\gamma_m - \gamma_{m-1}$.

The second piece of analysis presented in Section VI examines variation in the estimated returns to over-education, according to whether or not the individual subsequently moves into a matched job, estimated at four points in time: 1991, 1996, 2001 and 2005. The analysis is performed by interacting a variable indicating the amount (number of levels) of over-education experienced by the individual at time t, OL_{it}, with an indicator of whether the individual is still over-educated in the subsequent period, OE_{it+1}. In order to reduce the number of interaction terms in the estimated equations, over-education returns are constrained to be linear in this specification, rather than estimated via a series of dummy variables for each level. This is equation 3 below. Before estimating this specification, a specification without interactions but with the linear over-education variable, OL_{it}, was estimated for the same four years (1991, 1996, 2001 and 2005) to provide a comparison. This specification is shown in equation 2.

$$\boldsymbol{Y_{it} = \beta X_{it} + \gamma_1 RQ^1_{it} + \ldots + \gamma_6 RQ^6_{it} + \alpha OL_{it} + \mu SU_{it} + \varepsilon_{it}} \qquad \textbf{(2)}$$

$$\boldsymbol{Y_{it} = \beta X_{it} + \gamma_1 RQ^1_{it} + \ldots + \gamma_6 RQ^6_{it} + \varphi OL_{it} + \pi(OL_{it} * OE_{it+1}) + \mu SU_{it} + \varepsilon_{it}} \textbf{(3)}$$

The subsequent over-education variable, OE_{it+1}, was interacted with the over-education variable rather than the required education variables, because the former is picking up the returns to individual characteristics while the latter is picking up the returns to job level characteristics. Since the interaction term is included to determine whether the wage returns vary by unobserved *individual* characteristics, as proxied by future job-matching, then interacting it with the over-education variable is more appropriate.

Finally, Section VII investigates whether the over-education penalty is related to the characteristics of the job or to the characteristics of workers in over-educated jobs, by

analysing whether the wage penalty stays with individuals after they move into an appropriately-matched job, when compared to individuals who were always matched.[9] To do this, wage equations are estimated on samples of workers in matched jobs at t=1996, 2001 and 2005 respectively, which include a dummy variable for whether individual i was over-educated at t=1991, $OE_{it=1991}$.[10] This is equation 4.

$$Y_{it} = \beta X_{it} + \gamma_1 RQ^1_{it} + ... + \gamma_6 RQ^6_{it} + \lambda OE_{it=1991} + \mu SU_{it} + \varepsilon_{it} \quad (4)$$

Hence λ measures the pay differential in 1996, 2001 and 2005, between workers who were always in an appropriately matched job, and workers who were over-educated in 1991.

Finally, we estimate equation 4 again including an interaction between whether the individual was over-educated in 1991 ($OE_{it=1991}$) and a variable indicating that the individual's highest qualification is a degree (HQ^5_{it})[11]. This specification allows us to determine whether the effect of a history of over-education on future matched wages is the same for graduates and non-graduates. This is equation 5.

$$Y_{it} = \beta X_{it} + \gamma_1 RQ^1_{it} + ... + \gamma_6 RQ^6_{it} + \theta OE_{it=1991} + \sigma(HQ^5_{it} * OE_{it=1991}) + \mu SU_{it} + \varepsilon_{it} \quad (5)$$

In this specification, σ measures the difference in the penalty to previous (1991) over-education between graduates and non-graduates.

IV DATA AND DESCRIPTIVE INFORMATION

The British Household Panel Survey (BHPS) is a longitudinal survey of households in Great Britain.[12] The first wave of data was collected in 1991 with the survey then repeated each year. We use date from the first 15 waves (1991-2005). In the first wave, a nationally representative sample of 10,000 individuals, in 5,000 households, were interviewed from 250 areas of Great Britain. In subsequent years these same individuals were re-interviewed, as were any new members of their household, plus members of the new households of any individuals who left their original household, as well as new households to replace any households that left the survey. Information was collected at both the individual and household level, and includes individual questions on human capital and qualifications, as well as socio-economic characteristics such as income, employment status and region of residence, and job characteristics such as promotion prospects and firm tenure.

The BHPS data have been used to generate an unbalanced panel which includes all subsequent households added to the survey after 1991, and also a balanced panel. This provides an unbalanced working sample of 31,776 male and 34,904 female observations, of individuals in paid employment, whilst the balanced panel consists of 9,810 male and 9,660 female observations.[13] Table A1 in the appendix provides summary statistics for real weekly pay, as well as all the explanatory variables used throughout the analysis.

Given that the Quarterly Labour Force Survey (QLFS) has a much larger sample size than the BHPS, these data are used to calculate required qualifications (RQ_j) using the modal qualification by occupation category *j* averaged across 1993-2003. Table 1 compares the HQ_i variable in the BHPS with that calculated using a working age sample of men and women from the QLFS, 1993-2003. Table 1 also compares HQ_i for the earliest common period in each data set (1993). Whilst the distribution of HQ_i is close across the two datasets in 1993, there is some evidence of non-random attrition in the BHPS pooled data, since there are slightly more people at the top end of the qualification distribution, compared to the QLFS. This suggests that the later periods in the BHPS are less nationally representative than the earlier periods.

<Table 1 here>

Using the QLFS, we generated the *required* qualification (RQ_j) variable using the mode level of HQ_i by three-digit Standard Occupational Classification (SOC90), averaged over the full 11 year period for which such data were available.[14] This RQ_j variable was then matched into the BHPS by SOC90. As a consequence of the BHPS attrition, we expect to slightly over-estimate the true extent of over-education using the pooled BHPS data. The raw BHPS data show that 27 of men and 25 percent of women were over-educated in 1991.

To investigate whether over-education is permanent, Table 2 looks at transitions out of over-education for a balanced panel of 654 men and 644 women employed between 1991 and 2005. The first row shows that after 5 years, 26 percent of men and 23 percent of women over-educated in 1991 found a match, which implies that 74 percent of men and

77 percent of women were still over-educated. This falls to 53 percent of men and 59 percent of women after 15 years (100 men and 107 women, out of the 189 men and 180 women over-educated in 1991, were still over-educated in 2005). So half of those over-educated in 1991 eventually find a match by 2005. Table 2 also shows though that the likelihood of leaving over-education falls the longer workers are over-educated since an increasing percentage over time remain over-educated from one period to the next

<Table 2 here>

V PANEL DATA ANALYSIS OF ORU EARNINGS EQUATIONS

The aim of this section is to use the BHPS data to estimate wage equations to investigate whether the wage penalties to over-education, that are typically observed in the literature, are still observed when we use the panel nature of our data to estimate fixed effects equations.[15] This will determine how much of the observed wage penalty can be explained by unobserved heterogeneity.

The existing empirical literature shows that over-educated workers receive a wage penalty, their earnings ranging between 15 and 37 percent less than their appropriately-matched peers using recent cohorts.[16] However controlling for self-reported skills (Chevalier and Lindley, 2006) and taking unobserved heterogeneity into consideration (Chevalier, 2003) reduces this pay penalty.

<Table 3 here>

Table 3 presents the key educational returns for the ORU earnings equations estimated using OLS and fixed effects, as defined by equation (1).[17] The first column shows the

standard OLS wage equation using the ORU specification for men. As expected, the incremental return to a level of required education is almost always greater than that to all over-education levels. The largest increment for required education is a move from Level 2 to Level 3 (0.27 log percentage points or 31 percent) followed by a move from Level 4 to Level 5 (0.23 log percentage points or 26 percent). In comparison each incremental level of over-education is associated with around a 0.04 – 0.07 log percentage points (5 – 7 percent) increase in wages.[18] Another finding of interest is that the returns to required education are higher for women than for men, whilst the returns to over-education are lower for women, comparing columns 1 and 3.

The second and fourth columns in Table 3 provide the fixed effects estimates for men and women respectively in the ORU model.[19] Once we control for individuals' unobserved heterogeneity, we would expect an individual to earn the same whatever job they do, if over-education is simply an indicator of unobserved heterogeneity, and therefore the penalties would be close to zero. Also controlling for fixed effects, men and women still earn different amounts depending on the level of job they do, suggesting that the over-education wage penalty is not simply a penalty for low ability. As an aside, the return to under-education is negative and smaller than the weighted average for required education, which is in keeping with the consensus in the existing literature (see Hartog 2000).

The penalties to over-education cannot be read directly from Table 3, therefore Table 4 summarises the predicted wage premia at each job level for a particular education group,

namely graduates (HQ Level 5), all measured relative to individuals with no qualifications working in a matched job, and calculated using the estimated coefficients in Table 3. The wage penalties to working in a non-graduate job for these graduates can then more clearly be seen as the difference between the predicted wage premia at Level m (for m<5) relative to the Level 5 wage premium. These wage penalties are given in parentheses in each row of Table 4, for added clarity.

The upper panel of Table 4 refers to the OLS estimates. The first row shows that matched graduate men earn on average 0.77 log percentage points more than unqualified men working in matched jobs. The subsequent rows show lower wage premia, relative to unqualified men again, for graduate men working in all job below graduate level. For example, a graduate man employed in a non-graduate job (say RQ Level 3, so he has 2 levels of over-education) would receive a wage return to his qualifications of 0.67 log percentage points more than a matched man employed in an occupation that requires no qualifications. Hence, his over-education penalty is 0.09 log percentage points (10 percent). A similar wage penalty (13 percent) is suffered if the graduate man works in a Level 4 job, while the penalties are significantly larger if he is excessively over-educated and works in a Level 1 or Level 2 job.

<Table 4 here>

Since the returns to required education are higher for women than for men, whilst the returns to over-education are lower, consequently the over-education penalties are also higher for women. For example the over-education penalty for graduates employed in a job that requires Level 3 qualifications is 0.09 log percentage points (10 percent) for men

and 0.25 log percentage points (28 percent) for women. This is consistent with the literature since Lindley (2008) finds an estimated over-education penalty of 29 percent for women for QLFS data averaged over 1993-2002.

The second panel in Table 4 provides similar wage premia and over-education penalties for graduates, based on the fixed effects estimates. Once we control for individuals' unobserved heterogeneity, we would expect an individual to earn the same whatever job they do, if over-education is a proxy for lower ability. Hence we would expect the over-education penalties to be zero. Table 4 shows that the over-education penalties for the fixed effects model are lower than the OLS, as expected, but they do not disappear. Thus, once we control for unobserved heterogeneity, a wage penalty still exists, that grows (non-linearly) with the extent of over-education. So unobserved heterogeneity appears to be responsible for a significant proportion of the over-education effects, but cannot be the only explanation for the existence of over-education, which is consistent with Chevalier (2003).

There are two more issues to address concerning the estimated wage equations in this section. First, of necessity, they are estimated on a sample of individuals who are in work. We therefore estimated Heckman selection models for employed status before the wage equations were estimated, but found the results presented above to be unaffected, both qualitatively and quantitatively.[20]

Second, in the fixed effects estimates, the effect of over-education on wages is identified by workers making transitions between differently matched jobs. It is reasonable to suspect that such transitions will not be entirely random, and therefore the fixed effects estimates of the wage returns to over-education may not be typical of these received by all over-educated workers. We therefore turn to our other wage analyses, to search for further evidence on the unobserved heterogeneity theory.

VI RETURNS TO OVER-EDUCATION BY FUTURE MATCHED STATUS

Table 5 provides the results for equations (2) – (5) where these have been estimated on workers observed in 1991, 1996, 2001 and 2005, for a sample of pooled men and women in order to maintain sensible sample sizes.

Equation 2 is estimated for both an unbalanced and a balanced panel. This is the ORU wage equation as estimated in the previous section, except now estimated separately by year, and with the extent of over-education entered as a single variable. This is estimated in order to provide a base for the following results, which share these same characteristics. The over-education returns increased slightly from 0.065 to 0.08 log percentage points per level of over-education between 2001 and 2005, suggesting a slight increase in such returns. The results estimated on the 1298 individuals in the balanced panel in 1991, 1996, 2001 and 2005, tell a similar story.

The estimated results from equation 3 allow the estimated returns to over-education in any year to differ according to whether or not workers are subsequently matched, estimated on the balanced panel. The results show that the over-education return received in 1991 ($\hat{\phi}$) for those working in an over-educated job in 1991 was 0.12 log percentage points per level of over-education for those who subsequently found a match in 1996 compared to 0.04 log percentage points ($\hat{\phi} - \hat{\pi}$) for those who were still over-educated in 1996 (and compared to the average over-education return of 0.06 percentage points found in the equation 2 results for the balanced panel). These results therefore show that, holding constant job requirements at a particular level, there will be variation in the wage penalty suffered by over-educated employees working at that level. Those who will have found a matched job five years later are already earning a higher wage (a smaller over-education wage penalty) during their period of over-education. This suggests that the over-education penalty is not simply a function of the lower status job that over-educated individuals find themselves in, but is also a function of the heterogeneity of the workers themselves. This is consistent with the idea that workers with higher quality skills are earning more in their over-educated job and are more likely to move into a matched job. In other words, there are (at least) two types of over-educated workers: those who are temporarily over-educated but find a match within five years (around 25 percent of the sample according to Table 2) and those who take longer to find a match, who are of lower ability. Thus, heterogeneous ability again seems to be part of the story behind over-education.

The following rows in the 1991 column of Table 5 show that the further into the future a worker has to wait before they get matched, the smaller their advantage in terms of returns to over-education in 1991, relative to those who never get matched, since the $\hat{\pi}$ coefficients decline in size and are no longer statistically significant. Thus, in the hierarchy of over-educated workers, those who find a matched job sooner, earn higher wages whilst still over-educated, suggesting that they were of higher quality in the first place.

Similar results are observed in subsequent years, with the coefficient on the interaction term between over-education levels and future over-education status also being negative, though it fails to obtain statistical significance again. As Table 2 showed, however, the numbers observed in the data set who are still overeducated in the later years do become quite small, which may explain the lack of statistical significance. One finding that the shown by the subsequent rows of results for equation 3 is that, for those individuals who find a match in 2005, their returns to over-education increase as they get closer to their match date, as shown by ($\hat{\phi}$) at 1991, 1997 and 2001 in the `found a match in 2005' row.

VII WAGE PENALTIES TO PREVIOUS OVER-EDUCATION STATUS

The lower rows in Table 5 show the results of estimating equations 4 and 5, which reveal the impact of previous over-education status on the wages of workers who are now

matched. In particular, the equation 4 results show that, amongst matched workers in 1996, 2001 and 2005, those who were over-educated in 1991 but then subsequently found a match, earn 0.10 - 0.12 log percentage points (11-13 percent) lower wages compared to those who were already matched in 1991 ($\hat{\lambda}$). Thus, once again wages are shown to be determined not just by the characteristics (level) of the jobs, but also the unobserved ability of the workers who fill them, here indicated by prior over-education experience. Thus, holding job requirements constant at a particular level (and therefore holding actual qualifications constant at the same level, since equation 4 is estimated only on matched workers), lower wages, presumably reflecting lower unobserved ability, are observed for those individuals who were previously over-educated. Over-education is again at least in part determined by unobserved ability.

The final rows in Table 5 show that the negative impact of previous over-education on matched wages is not present for graduates who find a match within 5 years, since in 1996 graduates who were previously over-educated in 1991 earn the same as (actually an insignificant 0.004 log percentage points (0.4 percent) more than) workers who were already matched in 1991.[21] Thus, over-education is not an indication of lower ability within a qualification category for graduates who found a job within five years. Such a relatively short period of over-education for graduates can be seen as a natural event with no future consequences, as they learn about a firm or job, before being offered responsibilities commensurate with their skills. For non-graduates and graduates who taker longer than 5 years to find a match, over-education is apparently an indicator of lower ability, given the permanent wage penalty suffered by such individuals even when

matched, again providing evidence that those who find a match within 5 years are of higher ability relative to those who take longer.

VIII CONCLUDING COMMENTS

This paper has estimated a range of wage equation analyses, in order to investigate the hypothesis that over-education is, at least in part, an indicator of lower ability among groups of workers who are identically qualified, but who have heterogeneous unobserved abilities. Key evidence in support of this argument is that, amongst those workers who were over-educated in 1991, they did not all receive the same wage penalty to that over-education, even when conditioned on the level of required qualifications in their jobs. The over-education wage penalty was systematically smaller (only 4 percent rather than 13 per cent) amongst those workers who would be in a matched job five years later, in 1996. This result suggests some heterogeneity *amongst* the overeducated, such that those with the lowest ability (and hence the lowest wages) remain over-educated longer. It must be admitted that amongst the over-educated in 1996 and 2001, we do not observe a *statistically significant* difference in the over-education wage penalty between those who subsequently find a matched job and those who do not, although the penalty is consistently smaller (wages are higher) for those who do go on to find a matched job, and small cell sizes, causing large standard errors and lower t-statistics is the probable cause of the statistical insignificance.

The previous result therefore suggests some heterogeneity in skills *amongst* the over-educated, with the more highly skilled (as indicated by higher initial earnings) being more likely to escape over-education. Results in the paper also suggest, however, that there is heterogeneity of skills *between* those who experience a period of over-education within the sample period and those who do not, holding constant the level of actual qualifications obtained. This is evidenced by the fact that a matched worker who was previously over-educated in 1991 earns less than a worker in the same level job who was always appropriately matched. The systematically lower wages at the same job level amongst those with a history of prior over-education is again taken as an indicator of lower unobserved ability amongst this group. An exception to this result, however, is amongst graduates who leave over-education within 5 years. For this group, there is no wage penalty to their prior over-education once they are in a matched job. *Temporary* over-education amongst graduates therefore need not be an indicator of lower ability, but may simply be part of the normal work history of some graduates as they acquire the work experience necessary to complement their higher level qualifications before they can move into graduate-level jobs.

Our results therefore indicate three levels of unobserved ability. From highest to lowest these exist amongst workers who were always in a matched job, then amongst workers who were over-educated but subsequently find a matched job, and finally amongst workers who remain over-educated. Given this, we would expect to find that controlling for unobserved heterogeneity would explain some of the difference in wages between currently matched and over-educated workers. This is exactly what is observed in

Section V above, where a substantial portion of the over-education wage penalty observed in the OLS wage equation is removed once we control for unobserved heterogeneity. A significant proportion of the over-education that we observe is therefore due to unobserved heterogeneity, such that *apparent* over-education is actually individuals working in jobs that are commensurate with their actual skills.

Table 1: Highest qualification (percent).

	BHPS		LFS	
	1993	1991-2005	1993	1993-2003
HNQF=0, No Qualifications	23	16	24	18
HNQF=1, <lower secondary	13	12	13	14
HNQF=2, lower secondary	22	19	20	21
HNQF=3, upper secondary	23	25	23	24
HNQF=4, post-secondary	9	12	10	10
HNQF=5, tertiary undergraduate	9	13	8	9
HNQF=6, tertiary postgraduate	2	3	2	4
N	6,578	98,949	52,715	529,745

Notes: All men and women, age 16-65.

Table 2: Over-education (OE) Permanence for a Balanced Sample of Men and Women in 1991, 1996, 2001 and 2005.

	1991		1996		2001		2005	
	Men	Women	Men	Women	Men	Women	Men	Women
OE	189	180	140	138	118	116	100	107
Percentage[A]	29	28	74	77	84	84	85	92
N	654	644	189	180	140	138	118	116

Notes: **A** is the percentage of over-educated in 1991 but then in subsequent years it is the percentage still over-educated in subsequent years. Eg 140 men are still over-educated in 1996 from the 189 men over-educated in 1991 or 74 percent.
This balanced sample consists of 1298 employed workers who have a full set of variables for 1991-2005.

Table 3: Key results for the educational returns to log real gross weekly pay.

	Men		Women	
	OLS	FE	OLS	FE
Req Ed level = 1 ($\hat{\gamma}_1$)	0.1178	0.1387	0.1594	0.1855
	(0.0118)***	(0.0139)***	(0.0165)***	(0.0193)***
Req Ed level = 2 ($\hat{\gamma}_2$)	0.2251	0.2267	0.3583	0.3528
	(0.0108)***	(0.0141)***	(0.0099)***	(0.0151)***
Req Ed level = 3 ($\hat{\gamma}_3$)	0.4955	0.4137	0.6210	0.5901
	(0.0098)***	(0.0160)***	(0.0125)***	(0.0195)***
Req Ed level = 4 ($\hat{\gamma}_4$)	0.5358	0.5152	0.8119	0.7650
	(0.0131)***	(0.0226)***	(0.0133)***	(0.0260)***
Req Ed level = 5 ($\hat{\gamma}_5$)	0.7669	0.6560	1.003	0.8862
	(0.0119)***	(0.0248)***	(0.0132)***	(0.0278)***
Req Ed level = 6 ($\hat{\gamma}_6$)	0.8570	0.7393	1.0718	1.0650
	(0.0242)***	(0.0388)***	(0.0230)***	(0.0411)***
Over-ed level = 1 ($\hat{\delta}_1$)	0.1107	0.1064	0.0511	0.0940
	(0.0073)***	(0.0091)***	(0.0072)***	(0.0091)***
Over-ed level = 2 ($\hat{\delta}_2$)	0.1783	0.1669	0.1325	0.2037
	(0.0090)***	(0.0123)***	(0.0096)***	(0.0138)***
Over-ed level = 3 ($\hat{\delta}_3$)	0.2164	0.2832	0.2032	0.3450
	(0.0111)***	(0.0160)***	(0.0125)***	(0.0179)***
Over-ed level = 4 ($\hat{\delta}_4$)	0.2579	0.3669	0.1984	0.4072
	(0.0277)***	(0.0298)***	(0.0315)***	(0.0360)***
Over-ed level = 5 ($\hat{\delta}_5$)	0.3065	0.5872	0.2501	0.6575
	(0.0474)***	(0.0432)***	(0.0741)***	(0.0814)***
Under Educated (μ)	-0.0735	-0.0785	-0.0968	-0.1137
	(0.0032)***	(0.0052)***	(0.0041)***	(0.0063)***
Constant	3.299	5.2429	3.215	4.6526
	(0.0395)***	(0.0252)***	(0.0425)***	(0.0324)***
Observations	31776	31776	34904	34904
Cross-wave person id		6680		7314
R-squared	0.61	0.60	0.68	0.65

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%.
Controls: age, age squared, children, spouse employment status, year dummies, regional dummy, union status, permanent job, part-time, promotion prospects, training, commute time, firm size dummies, industry dummies, moved home for and not for job purposes and employment tenure. The fixed effects specification excludes age and age squared given that the time variation does not vary across individuals.

Table 4: Returns for a graduate (NQF Level 5 qualification) by job requirement level

(i) OLS

	Men	Women
Level 5 ($\hat{\gamma}_5$)	0.767	1.003
Level 4 ($\hat{\gamma}_4+\hat{\delta}_1$)	0.536+0.111=0.647	0.812+0.051=0.863
($\hat{\gamma}_5$ -[$\hat{\gamma}_4+\hat{\delta}_1$])	(0.12)*** [0.0124]	(0.14)*** [0.0121]
Level 3 ($\hat{\gamma}_3+\hat{\delta}_2$)	0.496+0.178=0.674	0.621+0.133=0.754
($\hat{\gamma}_5$ -[$\hat{\gamma}_3+\hat{\delta}_2$])	(0.093)*** [0.0110]	(0.249)*** [0.0129]
Level 2 ($\hat{\gamma}_2+\hat{\delta}_3$)	0.225+0.216=0.441	0.358+0.203=0.561
($\hat{\gamma}_5$ -[$\hat{\gamma}_2+\hat{\delta}_3$])	(0.326)*** [0.0127]	(0.442)*** [0.0139]
Level 1 ($\hat{\gamma}_1+\hat{\delta}_4$)	0.118+0.258=0.376	0.159+0.198=0.357
($\hat{\gamma}_5$ -[$\hat{\gamma}_1+\hat{\delta}_4$])	(0.391)*** [0.0291]	(0.646)*** [0.0348]

Notes: Log percentage points from the OLS specification in Table 3.
The penalties relative to a matched graduate are in parentheses, whilst the standard errors of these penalties are in square brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%

(ii) FE

	Men	Women
Level 5 ($\hat{\gamma}_5$)	0.656	0.886
Level 4 ($\hat{\gamma}_4+\hat{\delta}_1$)	0.515+0.106=0.621	0.765+0.094=0.86
($\hat{\gamma}_5$ -[$\hat{\gamma}_4+\hat{\delta}_1$])	(0.035)** [0.0157]	(0.027) [0.0187]
Level 3 ($\hat{\gamma}_3+\hat{\delta}_2$)	0.414+0.167=0.581	0.590+0.204=0.794
($\hat{\gamma}_5$ -[$\hat{\gamma}_3+\hat{\delta}_2$])	(0.075)*** [0.0126]	(0.092)*** [0.0162]
Level 2 ($\hat{\gamma}_2+\hat{\delta}_3$)	0.227+0.283=0.51	0.353+0.345=0.698
($\hat{\gamma}_5$ -[$\hat{\gamma}_2+\hat{\delta}_3$])	(0.146)*** [0.0139]	(0.188)*** [0.0167]
Level 1 ($\hat{\gamma}_1+\hat{\delta}_4$)	0.139+0.367=0.506	0.186+0.407=0.593
($\hat{\gamma}_5$ -[$\hat{\gamma}_1+\hat{\delta}_4$])	(0.15)*** [0.0287]	(0.293)*** [0.0364]

Notes: Log percentage points from the FE specification in Table 3.
The penalties relative to a matched graduate are in parentheses, whilst the standard errors are in square brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Returns to a level of over-education by key cross-sections.

	1991	1996	2001	2005
Equation (2)				
Unbalanced Panel ($\hat{\alpha}$)	0.065***	0.065***	0.083***	0.079***
	(0.009)	(0.009)	(0.008)	(0.008)
N	[4869]	[3909]	[4385]	[3630]
Balanced Panel ($\hat{\alpha}$)	0.059***	0.045***	0.071***	0.094***
	(0.016)	(0.016)	(0.015)	(0.008)
N	[1298]	[1298]	[1298]	[1298]
Equation (3)				
Found a match in 1996 ($\hat{\phi}$)	0.123***	-	-	-
	(0.024)	-	-	-
Differential between matched and OE in 1996 ($\hat{\pi}$)	-0.080***	-	-	-
	(0.026)	-	-	-
Found a match in 2001 ($\hat{\phi}$)	0.091***	0.082	-	-
	(0.027)	(0.049)	-	-
Differential between matched and OE in 2001 ($\hat{\pi}$)	-0.041	-0.042	-	-
	(0.028)	(0.05)	-	-
Found a match in 2005 ($\hat{\phi}$)	0.076***	0.086**	0.109***	-
	(0.027)	(0.036)	(0.031)	-
Differential between matched and OE in 2005 ($\hat{\pi}$)	-0.022	-0.049	-0.045	-
	(0.028)	(0.025)	(0.029)	-
Equation (4)				
Penalty to matched now, previously over-educated,	-	-0.122***	-0.118***	-0.10***
workers, relative to those already matched in 1991. ($\hat{\lambda}$)		(0.043)	(0.041)	(0.042)
N		[897]	[837]	[772]
Equation (5)				
Penalty to matched now, previously over-educated,	-	-0.147***	-0.114**	-0.079*
non-graduates, relative to those already matched in 1991. ($\hat{\theta}$)		(0.043)	(0.041)	(0.042)
Differential in penalty to previous over-education between	-	0.151*	-0.026	-0.095
non-graduates and graduates ($\hat{\sigma}$)		(0.09)	(0.117)	(0.117)

Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%.
Controls: age, age squared, children, spouse employment status, year dummies, regional dummy, union status, permanent job, part-time, promotion prospects, training, commute time, firm size dummies, industry dummies, moved home for and not for job purposes and employment tenure.

Table A1 : Sample means by unbalanced and balanced panel

	Unbalanced Panel		Balanced Panel	
Variable	Men	Women	Men	Women
Real Weekly Pay	5.92	5.26	6.10	5.43
Age	38.15	38.22	40.26	40.87
Job Tenure	4.79	4.08	5.83	5.08
Children	0.39	0.40	0.46	0.43
Employed Spouse	0.56	0.63	0.64	0.72
Non-Employed Spouse	0.16	0.07	0.15	0.06
No Spouse	0.29	0.30	0.21	0.22
Union Member	0.27	0.27	0.33	0.34
Permanent Job	0.93	0.91	0.98	0.96
Part Time	0.07	0.38	0.02	0.33
Promotion Prospects	0.86	0.86	0.84	0.85
Received Training	0.22	0.24	0.20	0.23
Commute Time	24.43	20.40	24.33	20.94
Ag, Forestry & Fishing	0.01	0.01	0.01	0.00
Energy & Water	0.03	0.01	0.04	0.01
Mining/Min Metals manu & Chemicals	0.08	0.02	0.09	0.02
Engineering & vehicles	0.12	0.04	0.13	0.04
Other Manufacturing	0.10	0.05	0.10	0.05
Construction	0.09	0.07	0.07	0.06
Dist, Hotels & Catering	0.15	0.18	0.13	0.15
Transport & Comms	0.13	0.08	0.13	0.09
Banking, Finance etc	0.12	0.21	0.12	0.22
Other Services	0.16	0.33	0.17	0.34
Moved house for Emp	0.02	0.02	0.01	0.01
Moved not for Emp	0.12	0.12	0.07	0.07
Lives in London	0.09	0.09	0.08	0.08
No Quals	0.10	0.12	0.09	0.11
HQNF=1	0.09	0.11	0.09	0.12
HQNF=2	0.15	0.23	0.16	0.28
HQNF=3	0.33	0.21	0.36	0.23
HQNF=4	0.12	0.14	0.11	0.13
HQNF=5	0.16	0.15	0.14	0.11
HQNF=6	0.05	0.03	0.04	0.03
Firm Size 1-24 Emp	0.29	0.38	0.24	0.34
Firm Size 25-99 Emp	0.25	0.25	0.26	0.27
Firm Size 100-499 Emp	0.26	0.19	0.29	0.21
Firm Size >500 Emp	0.20	0.18	0.21	0.18
Number of observations	31776	34904	9810	9660

Notes: The unbalanced sample contains joiners and leavers as well as individuals that have experienced spells out of work. The balanced panel is for workers observed in 1991 and 2005.

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ENDNOTES

[1] See the Department for Innovation, Universities and Skills Statistical First Release 'Participation Rates in Higher Education: Academic Years 1999/2000 – 2007/2008' (March 2009).

[2] Source: Department for Children, Schools and Families: Education and Training Statistics for the United Kingdom: http://www.dcsf.gov.uk/rsgateway/DB/VOL/v000823/index.shtml

[3] This idea is usually associated with Sicherman (1991), who showed that the over-educated have, on average, shorter job tenure and work experience, consistent with the idea that they are in the early stages of their career. Buchel and Mertens (2004), however, contest the interpretation of this evidence.

[4] The original source of this idea is Frank (1978), who used it to explain 'differential over-education' between men and women. The idea was discussed further by, *inter alia*, Dolton and Vignoles (2000) and Green *et al*. (2002). Supporting evidence is provided by Buchel and Battu (2003), though McGoldrick and Robst (1996) do not find evidence in support of 'differential over-education'.

[5] See Groot and Maassen van den Brink (2000) and Hartog (2000) for reviews of this literature.

[6] For example, consider an occupation where a high proportion, say 75%, of the workforce are graduates. With the modal method, anyone with a degree in this occupation will be classified as adequately educated, as we would want them to be, no matter what qualification the remaining 25% of workers hold. However, if some workers can enter this occupation without a degree (substituting experience, for example) then the mean level of education in the occupation will be less than a degree, and depending on the size of the standard deviation, all the graduates in this occupation could appear over-educated.

[7] See, for example, Gregg and Manning (1997).

[8] A single dummy variable for under-education was used rather than a series of dummy variables for the extent of under-education, as was done for over-education, because under-education is not the focus of the analysis here, as well as the fact that fewer individuals are under-educated as are over-educated, therefore reducing the possibility to use the flexible specification.

[9] An alternative explanation for a wage penalty staying with previously over-educated individuals even when they are matched is scarring, whereby the individual's history of over-education is the cause of their lower wages, rather than specifically unobserved lower ability.

[10] Given that equation (4) is estimated on a sample of matched individuals the γ_m parameters will be the same as if they were estimated on the 6 dummy variables for actual highest qualifications held.

[11] As in equation 4, $HQ_{it} = RQ_{it}$ for this sample of appropriately matched workers.

[12] See Taylor et al. (1998) for a detailed discussion of the BHPS sampling procedure.

[13] The balanced panel consists of 654 men and 644 women with pay observed over the full 15 years. This gives a total sample of 9810 men and 9660 women. This implies that only 26 percent of the 4869 men and women observed in 1991 were still in the sample in 2005. This is higher than the usual attrition rate for the BHPS which was around 50 percent in 2004, simply because we had to omit all individuals without a full set of 15 years observed wage data. Hence around 25 percent of workers left employment at some point during the period observed. This will include individuals who have retired, which implies that an individual fewer than 15 years from retirement in 1991 will not be in the balanced panel. Younger people are therefore over-represented in the balanced panel. See Uhrig (2008) for details on attrition in the BHPS.

[14] Detailed occupational information is not provided at the SOC90 level after 2003 since this year saw the introduction of the SOC2000 measure. There is evidence suggesting that it is not possible to provide a direct mapping of SOC90 into SOC2000 at anything higher than the one digit level (see Elias and Purcell, 2004). In some cases the occupational categories were too small for calculating the modal HQ. Those occupational categories that contained fewer than 30 individuals were amalgamated to similar categories within the same 2 digit level, so that sensible estimates could be obtained.

[15] All the estimates in this section are qualitatively robust to the choice of an unbalanced panel. All models were also estimated on a balanced panel where only individuals present in all fifteen waves were used. Results are available from the authors on request.

[16] See Sloane *et al*.(1999); Battu *et al*. (1999); Dolton and Vignoles (2000); Chevalier (2003); Chevalier and Lindley (2006); Green and McIntosh (2007).

[17] The Chow test for gender differences across parameters provided a test statistic of 37.20 indicating that the structural determinants of pay differ by gender.

[18] Where percentages can be calculated using $[\exp(\beta)-1]\cdot 100$.

[19] If qualifications held are positively correlated with fixed effects because of unobservable ability, then we would expect the OLS estimates to be larger than the fixed effects estimates to the extent of the omitted variable bias. Indeed column 2 shows that this is the case for most of the over-educational returns.

[20] Full details are available from the authors on request. The first stage employment equations where identified using a series of identification parameters. These included industry level redundancy rates in 1992/3, regional unemployment rates in 1991, and individual access to a car.

[21] Non-graduates workers who gain a match in 1996, 2001 and 2005 earn 0.147, 0.114 and 0.026 log percentage points less than non-graduate workers who were matched in 1991 ($\hat{\theta}$). This differential is offset for graduates in 1996 since $\hat{\sigma}$ =0.151 which is significantly different from zero at the 10 percent level.